

Dismissing lexical competition does not make speaking any easier: A rejoinder to Mahon and Caramazza (2009)

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The swinging lexical network proposal (Abdel Rahman & Melinger, 2009a this issue) incorporates three assumptions that are independently motivated and pre-existing in the literature. We claim that the combination of these three assumptions provides an account for a wide range of facilitation and interference observations. In their comment, Mahon and Caramazza question the success of our proposal by challenging the individual assumptions at its core. However, most of their criticisms are built on misconstruals of our proposal. Here, we revisit their points and clarify our position with regard to their specific concerns. We maintain that competition models do not necessitate an over-complication of lexical selection but rather provide an elegant and consistent mechanism to capture many empirical observations.

Keywords: Lexical cohort activation; Competition; Semantic interference effect; Speech production.

In our article (Abdel Rahman & Melinger, 2009a) we proposed a framework of lexical selection by competition that is sensitive to the activation status of lexical cohorts. We outlined a swinging lexical network proposal that builds on three assumptions. First, rather than concentrating on one-to-one competition as a major determinant for semantic interference effects, we focus on the activation status of whole cohorts of inter-related lexical items that mutually co-activate each other, thus creating a mass of highly active

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units which together compete with the target entry for selection. Second, we assume a trade-off between contextually induced semantic facilitation and lexical competition. Context effects tend to be facilitation dominant when lexical competition is restricted to one-to-one relations and interference dominant when competition involves a cohort of active competitors (one-to-many competition). Third, we assume that the network dynamics are strongly affected by meaningful contexts gating the spread of activation at the conceptual level. Context-dependent dynamic adaptations of the conceptual system have a strong influence on lexical selection by flexibly recruiting cohorts of varying combinations and sizes.

We argued that the proposed framework explains a variety of reported facilitation and interference effects, some of which have been interpreted as evidence against lexical competition models. In their comment, Mahon and Caramazza (2009 this issue) questioned the explanatory scope of the proposal and criticised details of the swinging lexical network proposal. However, each of these criticisms is predicated on a flawed understanding of our three core assumptions. Therefore, in this response, we first discuss the criticisms and related misconceptions, clarifying our position along the way. We then discuss our proposal in light of two challenges Mahon and Caramazza identify for competition models. In the final section, we characterise some of the fundamental differences in our respective approaches in order to provide some backdrop for our differing views.

LEXICAL ACTIVATION LEVELS AND THE NUMBER OF ACTIVE COMPETITORS: WHAT DETERMINES THE AMOUNT OF COMPETITION?

Mahon and Caramazza offer two interpretations of our swinging lexical network proposal and discuss them as separate theoretical alternatives. However, contrary to their suggestion, the two interpretations are *not independent* of each other. According to one interpretation, the *number* of activated non-target words "...independently of the activation levels of those words" (p. 741) determines the amount of lexical competition. This is clearly not how we described lexical cohort activation in our article. The point we made is that the number of active competitors is an important factor because, due to contextual relations, these competitors *are mutually related and therefore co-activate each other*. The more inter-related competitors are active, the more strongly they activate each other, and the more competition they should induce. This is what we call the swinging lexical network. Thus, we do claim that the number of active competitors is an important factor for lexical selection latencies – not because of the number per se – but because of the strong influence that cohort size has on the

individual activation levels of these competitors (that mutually activate each other), yielding in sum strong competition.

According to the second interpretation we are "... (merely) emphasising the existing assumption that the (sum) level of activation of all words in the network is critical for determining the amount of competition" (p. 738) (e.g., Levelt, Roelofs, & Meyer, 1999; Roelofs, 1992). We are indeed incorporating this assumption as the major determinant for semantic interference effects. However, as discussed in our article, we argue that the *size* of the cohort of active competitors is a critical factor. If the duration of target selection depends on the sum level of activation of all active nodes, then an increasing number of co-activated and contextually linked entries will increase the individual activation levels and, as a consequence, the sum level of competing activation considerably, thus delaying lexical selection of the target.

For an example, consider the picture-word interference (PWI) paradigm. Upon presentation of an object picture (for instance, a mouse), the target concept (MOUSE) and semantically related concepts (e.g., ANIMAL via 'is a' relations; FOUR LEGS via 'has' relations) are activated. As a consequence of this activation spread, categorically related concepts that share these features such as RABBIT, DOG, HORSE, CAMEL, etc., and associatively related concepts such as CHEESE, are activated. Due to continuous bidirectional information transmission between the conceptual and lexical levels, all active concepts pass activation to and receive activation from their respective lexical entries. As a result of this mutual between-level spread of activation, not only the target but also related non-target lexical entries such as rabbit, dog, horse, camel and cheese are activated and conjointly compete for selection according to the Luce ratio.

Now let's examine how different types of distractor words interact with the spread of activation instigated by the target picture. A categorically related distractor (e.g., rabbit) will activate the lexical entry rabbit and, via the bidirectional links between concepts and lexical entries, will also activate other concepts and lexical entries related to rabbit; mouse, dog, horse, camel, etc. Thus, not only will the competitor *rabbit* itself receive converging activation from the picture and the distractor word, but so will a whole cohort of shared category members. Because these related lexical entries co-activate each other, the network is now swinging. According to the Luce ratio, this semantically inter-related cohort of highly activated lexical competitors will induce strong one-to-many competition, resulting in sizable interference effects.

The situation is different when the distractor word is, for instance, associatively related to the target but drawn from a different semantic category (e.g., cheese). In this case, concepts and lexical entries such as grapes, red wine, ragout fin, etc. (categorically related to cheese), and mouse

(associatively related) will receive activation from the distractor. In contrast to the scenario for categorically related distractors, however, the converging activation from picture and associate distractor is restricted to the target and a single competitor (the word itself) or a very small cohort; as most of the words related to the distractor are not also related to the target, activation does not resonate within a cohort of inter-related reciprocating items. Instead, activation from the two sources diverges onto mutually unrelated representations; the network is not swinging. Thus, in the case of associatively related distractors there is a comparatively weak one-to-one competition between the target and an isolated competitor. Naturally, in addition to the single strong competitor there are also many weakly active competitors, but this would also be the case when the distractor is unrelated to the target. The above described one-to-one account for facilitation-dominant semantic context effects is not restricted to associative relations. The same principles are assumed to hold for other types of distractors that tend to have a one-to-one relation to the target or co-activate a very small cohort, for instance semantically related verb distractors (e.g., bed, sleeping) or part-whole relations.

To summarise, neither of the interpretations of the swinging lexical network described and criticised by Mahon and Caramazza are accurate characterisations. Our cohort assumption hinges on both the size of the cohorts and the activation levels of the cohort members, which are intimately related with the cohort size. These two factors cannot be viewed separately or independently of each other. The more competitors from an inter-related semantic cohort that are co-activated, the more they will in turn activate each other (see also our discussion of the semantic distance effect, below). Thus, we explain effects of related distractors with the same mechanisms assumed to hold for one-to-one competition, namely, converging activation from target picture and distractor word. However, additionally, we take whole cohorts into account, not just single lexical competitors. We argue that this cohort activation has a much more powerful influence on competitive lexical selection than isolated competitors and their individual activation levels.

TRADE-OFFS BETWEEN CONCEPTUAL FACILITATION AND LEXICAL INTERFERENCE

The failure to appreciate the mechanics underlying cohort activation leads Mahon and Caramazza to challenge our assumption that there are trade-offs between contextually induced semantic facilitation and lexical competition. As an example, they discuss the facilitation observed in the PWI paradigm when distractors are parts of whole objects (Costa, Alario, & Caramazza,

2005). They argue that, according to Roelofs (1992) a part-of relation (e.g., target: car, distractor: bumper) should result in a higher activation level of the competitor compared to an unrelated word, and should therefore induce interference. A trade-off account, they argue, would have to assume stronger semantic priming than lexical competition effects. In fact, part-whole relations, as well as object-action relations, create the same competition scenario as associative relations (see discussion above), namely a situation in which the target and distractor do not activate a set of inter-related co-activating concepts. The flaw in their argument is the failure to incorporate a lexical cohort into the mix, thereby missing the crucial feature of the swinging lexical network proposal: It is the presence of a cohort that determines whether interference or facilitation wins out, not asymmetries in spreading activation, and not one-to-one relations.

Furthermore, it is interesting to note that the account advocated by Mahon and Caramazza also incorporates trade-offs. As they write, "On the account we have proposed, the within-category distance effect follows from the contrasting effects of facilitation (at the lexical level, due to semantic distance) and interference at the response-level, due to the presence of category coordinate distractors" (p. 737).

HARD-WIRED AND FLEXIBLE ASPECTS OF SEMANTIC NETWORK DYNAMICS

In their comment, Mahon and Caramazza misleadingly portray the semantic network's sensitivity to context as "biases on spreading activation" (p. 743) and argue that we have not specified the conditions for such biases. We reject this characterisation and take this opportunity to explain our view on dynamic lexical/semantic networks once more. In brief, we assume that the conceptual system and, mediated by the former, the lexical network, are shaped by meaningful associations and contexts extending beyond classic and hard-wired semantic relations that are stored in long-term memory (such as taxonomic categories). We assume that ad-hoc relations between concepts as well as ad-hoc categories that integrate related or unrelated concepts in a meaningful way (e.g., things to collect rain water when stranded on a desert island) can be flexibly formed as the context requires. Furthermore, we assume that these adaptations affect the activation status of lexical cohorts just as classic hard-wired relations do.

Although such flexible context adaptations have not yet gained much attention in speech production research, there is a rich research tradition examining the dynamics of contextual adaptations of the conceptual system on which we build our assumptions. This research strongly suggests that different facets of a concept's meaning are activated (or ignored) according

to the specific situational requirement or goal (Barsalou, in press). Thus, activation in response to a stimulus is not fixed across all contexts but plastic and modulated by context (Barsalou, 1983, 1985, 1991; Chrysikou, 2006; Vallée-Tourangeau, Anthony, & Austin, 1998; for recent reviews, see Barsalou, 1993, 2007). For instance, Barsalou (1982) reported faster extraction of object features (e.g., flammability as an attribute of newspapers) in relevant contexts (e.g., building a fire) than in neutral contexts. Furthermore, while a piano has classic taxonomic category members such as trumpet and harp, it might alternatively form a much better-suited category with objects such as washing machine and wardrobe when thinking about moving heavy furniture (e.g., Barclay, Bransford, Franks, McCarrell, & Nitsch, 1974).

Together, the discussed evidence implicates a high degree of flexibility and dynamic adaptations of the conceptual system. What we suggest here is that these conceptual adaptations shape the microstructure of lexicalisation by dynamically recruiting context-specific cohorts of varying combinations and sizes. For instance, objects such as bee, honey and bee keeper are categorically unrelated but they are all situation relevant as associates of the context apiary, and therefore, in combination, induce interference (Abdel Rahman & Melinger, 2007); similarly, objects such as bucket, coffee and stool are categorically and associatively unrelated. However, in the context of a fishing trip, they can be meaningfully integrated into a common semantic theme and should thus, as an inter-active lexical cohort, induce lexical interference (Abdel Rahman & Melinger, 2009b). These adaptations at the lexical level are not necessarily instantaneous, however. They build up over time as more evidence of a relevant context is accrued and convergent activation accumulates on related items. Consistent with this view, interference effects induced in the semantic blocking paradigm are not reliable in early presentations but take time to stabilise (e.g., Abdel Rahman & Melinger, 2007; Belke et al., 2005). Thus, contrary to the contention of Mahon and Caramazza, this pattern of emerging interference in the blocking paradigm is completely consistent and predicted by the swinging lexical network model.

To summarise, we agree with Mahon and Caramazza that "... the idea of contextually induced 'biases' on the spreading of activation is not new: if a set of related concepts are co-activated, those concepts will tend to mutually activate each other" (p. 744). However, and critically, we additionally assume that this mutual co-activation extends not only to well-established categorical relations but also to associative and newly formed ad-hoc relations.

As an alternative interpretation, Mahon and Caramazza suggest that "A much more radical notion of biases on the spreading of activation could stipulate the presence of structural constraints that guarantee that only a subset of words are in fact activated, compared to the entire set of nodes that

would otherwise be activated. For instance, it may be argued that lexical nodes corresponding to distractor words become activated only if those distractors are category coordinates of the target concepts. In this way, the proposal would redefine the construct of a 'lexical competitor' to only include words that are coordinates of the target concept" (p. 744). This is diametrically opposed to what we claim. We do not restrict spreading activation between levels, as Bloem and La Heij (2003) do. Indeed, our proposal depends upon continuous and bi-directional information transmission between the conceptual and lexical strata. As we suggest in our article, one of the advantages of our proposal is that it does not need any stipulations or constraints on specific types of semantic relations or structural constraints. Simply by incorporating existing and independently motivated components, such as the role of lexical cohorts and the flexibility of conceptual organization, we can account for facilitation and interference effects observed in a variety of experimental paradigms.

CHALLENGES TO THE ASSUMPTION OF LEXICAL SELECTION BY COMPETITION: POLARITY REVERSALS AND SEMANTIC DISTANCE EFFECTS

We will now turn to a discussion of the two challenges to lexical competition models proposed by Mahon and Caramazza. The authors focus on polarity reversals from interference to facilitation and on semantic distance effects. As discussed in the original article, we account for polarity reversals by assuming trade-offs between conceptual facilitation and lexical interference. If cohorts of inter-related lexical entries are invoked by contexts, we expect interference effects (e.g., when objects are named in blocks of categorically, associatively or thematically inter-related items or when categorically related distractor words are presented; Damian, Vigliocco, & Levelt, 2001; Abdel Rahman & Melinger, 2007, 2009b; Schriefers, Meyer, & Levelt, 1990). Alternatively, if conceptual facilitation is bypassed, competition in the absence of a cohort should be observable (e.g., when distractors are phonologically related to an associate; Melinger & Abdel Rahman, 2009). In contrast, conceptual facilitation in the context of one-to-one competition should result in null or facilitation effects (e.g., when activation from target and distractor converges to one or very few competitors; Abdel Rahman & Melinger, 2007; Costa et al., 2005; Mahon, Costa, Peterson, Vargas, & Caramazza, 2007, Experiments 1 and 2). These predictions are confirmed by observations in different experimental paradigms.

The second proposed challenge is graded semantic distance effects in the picture-word interference paradigm. Before turning to a detailed discussion we want to stress that we do not agree that the observation of faster response

latencies for semantically close compared with more distant distractors is such a critical challenge for the assumption of lexical competition. This is mainly because there are few empirical observations of such effects which yield heterogeneous results (see discussion in Abdel Rahman & Melinger, 2009a this issue). Furthermore, the amount of semantic priming induced by semantically near and far distractors will differ and thus will contribute to the size and polarity of the effect.

To account for semantic distance effects, we have suggested that the distance between the two stimuli may be confounded not only with facilitatory semantic priming effects but also with the size of the recruited lexical cohorts. For instance, when picture and word are semantically close (e.g., carp and trout) they spread converging activation to members of a comparatively small and narrow natural class (other fish). This follows not from the taxonomic organisation of the network, as Mahon and Camamazza suggest, but from the high proportion of semantic features shared by target and distractor; both have gills, scales, fins, swim in schools, etc. Most other animals do not share these features and thus will not be recruited into the cohort. The resulting co-activation of a small cohort produces a comparatively small competition effect. Additionally, semantically close distractors should yield comparatively strong (facilitatory) semantic priming effects, again resulting from the high proportion of shared semantic features. In contrast, when picture and word are semantically distant (e.g., carp and sheep) the set of shared semantic features is comparatively general, e.g., both move, are alive, are edible, etc. These general features characterise the nature class of animals. Thus, the target and distractor spread converging activation to a large set of concepts and lexical entries. The large and activated lexical cohort produces a relatively large competition effect while semantic priming should be weaker than the priming effects of close distractors. Thus, we assume that the trade-off between more semantic priming and less lexical competition induced by within-category semantically near distractors compared with less semantic priming and more lexical competition induced by within-category semantically far distractors accounts for the semantic distance effects discussed by Mahon and Caramazza.

Importantly, it is the combination of picture and distractor (the common context) that determines semantic activation spread at the conceptual and lexical level, not the structural properties of the isolated stimuli as such. This combination defines a common context, in this case based on the shared semantic features, that gates the activation flow at the conceptual and lexical level.

Future experiments will have to reveal whether our speculations on graded semantic distance effects are correct or not. In any case, they are not triggered by the assumption that "... distractor words and target pictures in the within-category semantically far condition do not share a common

superordinate node” (p. 739). Furthermore, assuming a common superordinate node in the semantically far condition, it is not the case that, as Mahon and Caramazza put it, “... it follows that that representation will also be activated by the same items (distractors and targets) when they appear in the within-category semantically close condition” (p. 740). We assume that part of this misconception of our proposal is related to different views on how semantic activation spread is realised and on the failure to take dynamic context-dependent adaptations into account.

GENERAL COMMENTS AND CONCLUSIONS

Finally, we want to stress some fundamental differences in our approach to studying lexical selection compared to the approach adopted by Mahon and Caramazza in their response exclusion hypothesis (REH), particularly with regard to how the extant literature is considered. A key point for the REH is that “... the typical pattern that is observed in the picture-word paradigm when comparing semantically related and unrelated distractor words is not interference: the typical pattern is semantic facilitation” (p. 736). This sentence reveals that Mahon and Caramazza are primarily concerned with explaining polarity reversals observed with the PWI task. As the authors state, ‘The Response Exclusion Hypothesis is, above all, a proposal about how conflicts that are induced by the picture-word (and Stroop) task are resolved within the speech production system’ (p. 746). By focusing primarily on the PWI literature, they conclude that semantic facilitation, but not semantic interference, is informative to lexical selection processes.

In contrast, we view the insights from other paradigms as pertinent and we believe they support our position that both interference and facilitation effects are relevant to understanding lexical selection processes. We maintain that if one considers other tasks equally, the claim of non-competitive lexical selection becomes untenable. Numerous studies using a variety of production tasks, such as (cyclic and non-cyclic) semantic blocking (Abdel Rahman & Melinger, 2007; Belke, Meyer, & Damian, 2005; Damian & Als, 2005; Howard, Nickels, Coltheart, & Cole-Virtue, 2006), semantic substitution elicitation (e.g., Vigliocco et al., 2004), and tip of the tongue resolution (Abrams & Rodriguez, 2005), report results that implicate lexical competition.

Mahon and Caramazza consider these data as orthogonal to the current debate. We disagree with this assumption but recognise the need for further research to confirm or disconfirm the involvement of lexical competition in these effects (e.g., see Aristei, Abdel Rahman & Melinger, 2009, for ERP

evidence for a tight functional and temporal coupling of distractor and blocking effects).¹

The REH locates semantic interference effects at the articulatory output buffer, where distractor words need to be discarded to make room for the target word. As Mahon and Caramazza explain “when a distractor word shares criteria that must be satisfied by a correct response, [excluding the distractor word] costs more time” (p. 736). However, even within the PWI literature there are reports of facilitation and interference effects that are problematic on this account. For example, associative facilitation has been reported even when distractors are valid naming responses in the experiment and thus share relevant response criteria with the target (Abdel Rahman & Melinger, 2007). Furthermore, slower naming latencies have been reported for semantically unrelated distractor words that differ from the target picture name in grammatical gender (e.g., Cubelli et al., 2005), or are phonologically related to a categorical or associate competitor (e.g., Jescheniak & Schriefers, 1998; Abdel Rahman & Melinger, 2008; Melinger & Abdel Rahman, submitted). These competitors should be easy to exclude from the response buffer because they are semantically unrelated. Yet, they slow naming times.

Finally, Mahon and Caramazza claim that one of the merits of their proposal is that it shifts the focus away from semantic interference toward the “dynamics of spreading activation at the semantic level, and how spreading activation facilitates processes involved in lexical access” (p. 746). We recognise the value of this shift in focus, which is why one of the three assumptions of the swinging lexical network proposal is that the spread of conceptual activation is sensitive to meaningful contexts in which a word is uttered. Dynamicism and flexibility in the conceptual system are core components here. This assumption motivates our investigations into, for example, the relationship between ad hoc category formation and lexical selection (Abdel Rahman & Melinger, 2009b). We therefore entirely agree that understanding the dynamics of conceptual activation and organisation is crucial to a deeper understanding of conceptually mediated lexical selection.

In conclusion, we reject Mahon and Caramazza’s charge that we have *unnecessarily complicated* the production process merely for the sake of salvaging lexical competition. Competition provides an elegant and comprehensive explanation for a host of empirical observations. Rather than throwing the baby out with the bath water, we believe our proposal provides

¹ Despite their implication to the contrary, the majority of proposals put forward to account for these effects incorporate some aspect of lexical competition (e.g., Abdel Rahman & Melinger, 2008; Damian & Als, 2005; Dell, Oppenheim, & Kittredge, 2008; Howard et al., 2006; Kroll & Stewart, 1994; Oppenheim, Dell, & Schwartz, 2007; Vigliocco et al., 2004).

an integrative account that covers a variety of effects from multiple experimental paradigms.

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